

Systems and Support

Survey Web Site
[http://www.sde/educator/
siteform.htm](http://www.sde/educator/siteform.htm)

As part of developing a technology plan, each school district must initially assess their specific needs and curricula to determine the type of system best suited to meet the learning goals established in the schools in the district. In making this determination, school districts will have to address issues such as procurement, maintenance, support, administration, hardware and software resources, **networking**, and updating. South Carolina's school districts are keeping an accurate quantitative inventory of technology hardware resources by using the South Carolina Department of Education's online survey.

Terms and Definitions
[http://
www.pcwcbodpedia.com](http://www.pcwcbodpedia.com)

In recognition of the rapid rate of change associated with technology, this section addresses these issues in general terms with hyperlinks to web-based resources and current technical data. Most technical terms are defined within this document, and web-based glossaries offer further explanation. Issues to be considered for systems and support design are divided into four main categories:

- I. Hardware and Software** - Includes information about standards; ratios; placement of hardware and software in classrooms, labs, media centers, offices and buildings; software; copyright; virus protection; and workstation security.
- II. Connectivity/Network Design** - Includes information about local area networks; workstations; servers; network operating systems; backups; cabling; **widearea** networks; e-mail servers; and security.
- III. Physical Design** - Includes information about issues such as electricity, lighting, and furniture.
- IV. Technical Support and Systems Maintenance** - Includes information about human resources and tools to maintain operational systems, maintaining hardware, **obsolescence**, and upgrades.

Sources of Input for Streamlining Systems and Support'

School districts have access to numerous resources to obtain information, assistance, and guidance in making technology-based decisions.

Vendors and Suppliers - Maintaining an on-going dialogue with representatives from your suppliers and vendors will provide a valuable education. Reputable vendors stay in business because of their ability to assist customers in the process of defining applications, reviewing choices, and evaluating solutions. Many vendors provide web pages, newsletters, and seminars. They can be a valuable source of information and insight into today's market and trends.

Seminars/Continuing Education - These resources may be provided by vendors as well as consultants and educational institutions. While attending such an event, other colleagues are available for networking information and comparing solutions.

On-site Visits to Other Sites - Some schools, districts, and members of the public and private sector may be willing to provide observation training which shows off the quality of their hardware and software choices. Target recognized leaders and seek to learn from their examples. Establish an internal benchmark for where you are now compared to where you want to be in the future. Look for successful implementations, compare solutions, and discover why some are more successful than others.

Trade Press - A great deal of information is available from trade journals and professional publications. Some are now available via the Internet as well as through traditional print sources. Keeping abreast of new products and applications will enhance your ability to provide quality service to your customers, the students.

'Gartner **Group/Datapro** 'Best of Breed and Best Practices", August 20. 1997.

National Benchmarks

According to the 1997 School Technology Readiness (STaR) Chart¹, some national benchmarks have been established for maintenance in low tech, mid tech, and high tech environments. Their findings are as follows:

Low Tech- Generally an environment of outdated classroom computers with maintenance performed off-site on an irregular basis.

Mid Tech- Generally a mix of outdated and multimedia computers with maintenance performed off-site on an irregular basis.

High Tech- Generally, a mostly multimedia computer environment with off-site, regular maintenance.

Target Tech- almost all multimedia computers with on-site continual maintenance.

The STaR Chart is a tool that provides information that districts and schools can use to determine their current profile and assess their progress in using educational technology.

Recommendations

1. It is recommended that each school district move toward full implementation of the technologies specified in the Systems and Support section of this plan which includes a minimum of five computers per classroom and two-way audio/video capabilities in each school.
2. It is recommended that each school district utilize best practices in establishing policies for systems management, procurement, and support.

¹CEO Forum on **Education & Technology School Technology and Readiness Report *From Pillars to Progress* - Year One. 1997.**

I. Hardware and Software

Standards

Examples of Standards Definitions

[http://www.odu.edu/
~occs/standards/
standard.htm](http://www.odu.edu/~occs/standards/standard.htm)

[http://
www.okc.cc.ok.us/
~jrichardson/my_stuff/
minimum.html](http://www.okc.cc.ok.us/~jrichardson/my_stuff/minimum.html)

It is important to establish and maintain standard system specifications for hardware and software. These standards should be defined based on your instructional program needs. They should be updated a minimum of once per year to reflect changes in available technologies. Having consistent standards will save your district considerable time and money for training and support. In addition, teachers and other staff members will be better able to assist one another and share data and resources much more readily with common applications and platforms.

Regular Classrooms (K-12)

Examples of Ratios Definitions:

[http://
www.ceoforum.org](http://www.ceoforum.org)

It is recommended that each classroom contain a teacher workstation and at least five student workstations. These computers will be networked to enable in-classroom printing and classroom-wide viewing/display. It is essential that classroom workstations be connected to the building local area network as well as the district wide area network.

Technology in Special Education

[http://
home.earthlink.net/~
thecatalyst/](http://home.earthlink.net/~thecatalyst/)

The inclusion of technological tools in and throughout each school classroom for instructional enhancement and student learning is a priority of this plan. For example, the specific technological requirements of courses in the visual and performing arts and assistive technologies for special education students should be addressed by each school district.

General Hardware/ Software Purchase Information

<http://www.cnet.com/>

It is also recognized that technological changes leading to rapid hardware obsolescence, professional development requirements, and funding source availability will require an effective phase-in of these tools at a pace that parallels industry trends, instructional staff readiness, and resource availability. Telephones in classrooms will provide an added measure of security in addition to enabling students and teachers to participate in teleconferences and other interactive learning opportunities. The standard student workstation configuration for schools will be the same general configuration as the teacher workstation, including stereo

**Current SC State IT
Contracts**
[http://www.state.sc.us/
mmo/contracts/
itsclist.htm](http://www.state.sc.us/mmo/contracts/itsclist.htm)

Basic Classroom Components

- One teacher workstation
- Five student workstations
- One large-screen television monitor/receiver (35")
- One networked color printer
- One telephone

Computer Labs

It is recommended that each school (K-12) consider the use of computer labs appropriate to the size of the student population and instructional program. These labs will be utilized for keyboarding instruction, word processing, media production, project development, and other instructionally specific applications. As students progress to higher grade levels, labs will be increasingly used for more specialized instruction.

Hardware Reviews and Sources

[http://
www.applicationsguide.
com/](http://www.applicationsguide.com/)

[http://www.techweb.com/
shopper](http://www.techweb.com/shopper)

[http://www.erols.com/
chare/hardware.htm](http://www.erols.com/chare/hardware.htm)

<http://www.zdnet.com/>

[http://
www.reviewfinder.com/
O/O.htm](http://www.reviewfinder.com/O/O.htm)

Basic Computer Lab Components

- One teacher workstation
- Twenty-five student workstations
- One large-screen television monitor/receiver (35") or projection device (LCD projector or LCD panel)
- One networked laser printer
- One networked color printer
- One telephone and regular business phone line

Specialized Computer Lab Components

(May be needed, depending on course requirements)

- One networked graphics/CAD compatible plotter
- One stereo amplifier, audio tape deck, and appropriate speakers (integrated with teacher workstations)
- One closed circuit video microscopy system
- Five spectrophotometers
- Five OHAUS Electronic Balances
- Five General Purpose Probes

Media Centers

It is essential that school library media centers incorporate today's technology and automation services as we prepare students for lifelong learning and develop their ability to access, evaluate, and use information. Automation of a media center incorporates the functions of an online public access catalog, circulation, inventory, and reporting.

A school and/or district-wide media automation application should:

- Provide for such media center activities as on-line catalog, circulation, search, checkout, interlibrary loans, and inventory.

- Be customizable per school building and be capable of providing a hierarchical view of various buildings and district collections.

- Include all necessary hardware and software to provide online catalog, circulation, search, checkout, and inventory throughout each school building.

- Be fully integrated with each building's local area network as well as the district wide area network and the state network.

Basic Media Center Components

Automation software package

One circulation (checkout) station per **300** students equipped with appropriate barcode reader/scanning device dedicated to resource reservation and checkout

One student catalog and research station per 100 students

One student creativity station per 300 students which includes:

- One workstation

- One color printer

- One large screen television monitor/receiver (35")

- One projection device (LCD projector or LCD panel)

- One level III laserdisc player

- One camcorder

- One color flatbed scanner

- One color digital camera

**Trends, Product
Reviews, and Articles
Regarding IT Sorted by
Industry, Including
Education**

[http://
www.pubs.cmpnet.com/
internetwk/](http://www.pubs.cmpnet.com/internetwk/)

**Interviews and Reviews
of Products and Trends**

[http://
www.realcomputing.com/](http://www.realcomputing.com/)

**Magazine Reviews of
Products**

[http://www.zdnet.com/
findit/mags.html](http://www.zdnet.com/findit/mags.html)

Administrative Resources and Non-classroom Locations

It is recommended that each administrative employee in the school be provided with a networked computer workstation equipped comparably to student workstations. At least one laser printer and five color inkjet printers (for administrative and supportive functions) is recommended for each 300 students attending the school.

Basic Administrative Components

- One networked workstation per administrator or support staff person
- One color inkjet printer per **60** students
- One laser printer per 300 students

Building Wide Resources

Each school building local area network should include appropriate components. The following listing is intended to be used as a general guideline. Specialized applications or directed processes may warrant inclusion of additional components.

Basic Building Components

- One building file server able to support all administrative and classroom computers
- One CD-ROM tower
- One networked postscript capable laser printer
- One flat-bed color scanner
- One projection device/panel for each 300 students for use in various areas of the school
- Fax capability

Software

Technology can be used to support specific skills and to foster creativity in the classroom, as well as to facilitate information access and use. Resources can be used to support whole class, small group, or individual instruction. Regardless of grade level, multimedia programs are available to be used for construction and presentation of student projects to include sound and video, which can be captured from multiple media such as video tapes, CD-ROMs, video disks, television, and the Internet.

The Internet can be used extensively in all classrooms at all grade levels. With connections to the Internet, students can work alone or in groups on various projects. They can begin researching a project by electronically checking to see what books are in their own school library media centers, other district libraries, the public library, the university libraries; by asking questions on some electronic discussion lists; and by browsing Internet sites to locate pictures, maps, graphics, movie clips, and other information specific to their project.

Multimedia CD-ROM resources and software packages present databases of hundreds of types of statistical information regarding people, counties, demographics, and economics. These resources serve as interactive research tools offering much more than a textbook. Most programs have extensive multimedia components which offer full motion video, sound, still images, as well as comprehensive text. Students can use these resources for projects based on classroom instruction or for individual/group projects. Students can also create their own databases for presentation of information they have discovered for projects and other assignments.

Software in the Media Center

A common library automation package throughout the district will enable students and teachers to use the application effectively as well as provide training to library media specialists and staff on a district basis. In addition, district purchase of online resources can provide for reduced costs

**Choosing School
Software**
[http://www.siec.k12.in.us/
~west/article/soft.htm](http://www.siec.k12.in.us/~west/article/soft.htm)

on purchases as well as district wide training.

Software in Administrative Offices

Software Reviews

[http://
www.evalutech.sreb.org/](http://www.evalutech.sreb.org/)

<http://www.benchin.com/>

[http://www.ucc.uconn.edu/
~wwwpsce/wcool.html](http://www.ucc.uconn.edu/~wwwpsce/wcool.html)

[http://
www.worldvillage.com/wv/
school/html/scholrev.htm](http://www.worldvillage.com/wv/school/html/scholrev.htm)

A state supported administrative package for attendance, scheduling, and other school administrative applications provides the ability to transfer data throughout the district and deliver state wide training.

Instructional Software

Allowing teachers to have input into the purchase of instructional software will help ensure the effective use of the software. Demonstrations from vendors to groups of teachers encourages the interchange of ideas and additional uses of the materials. A district wide purchase usually results in reduced costs and training.

Choosing a standard application suite for word processing, database, and spreadsheet package allows for district wide training and provides the staff the ability to share information and tips on using the packages and to brainstorm for additional uses of the software.

Copyright

One major issue of concern to all educators in using computer software is the copyright law governing its use. All educators should strive to set an example for students by obeying the copyright laws. Each school district should have a copyright policy concerning the use of all copyrighted material.

Anti-Virus:

As schools go online, risks of damage to computers by electronic viruses increase substantially. The likelihood of encountering a virus has increased sharply over the last year. Downtime and lost files can be aggravating at the very least. Tremendous amounts of time and effort can be expended fighting viruses once infections start. Investment in a good anti-virus program with regular updates can pay for itself quickly.

Copyright Issues

[http://www.ala.org/library/
fact16.html](http://www.ala.org/library/fact16.html)

[http://www.ala.org/library/
fact07.html](http://www.ala.org/library/fact07.html)

[http://www.benedict.com/
fund.htm](http://www.benedict.com/fund.htm)

II. Connectivity/Network Design

Local Area Network

Ethernet Networks
<http://www.ots.utexas.edu/ethernet/>

Network Specifications and Standards
<http://www.bicsi.org>

The Local Area Network (LAN) provides the connectivity among computers and other resources at the local level. The LAN allows computers to communicate with each other and with other networks throughout the rest of the world. A LAN is generally limited to connectivity within a single building or a group of buildings connected on a campus. Proper design and installation of the LAN is crucial to the successful use of technology in the classroom.

Planning a LAN
<http://www.svi.org/netday/info/guidebook/>

Workstations: Personal Computers (PCs) which are used by students, teachers, and other staff are often referred to as workstations on the LAN. Specifications for workstations may vary based on user requirements. For example, students who are doing Internet research may require different workstations than administrative staff who are running administrative applications such as word-processing and student record keeping systems.

Microsoft Windows/NT Server
<http://www.microsoft.com/ntserver/default.asp>

Servers: Servers generally provide added functionality for workstations on the LAN. For example, they may hold applications software which is used by workstations, data which is shared by users, and private data belonging to individual users. They may provide other features such as print services, directory services, and security functions. They might also support communications functions such as e-mail and web server capabilities. The basic rule of thumb for servers is always buy the best you can afford. Adequate memory and disk space should be installed to avoid the need to upgrade in the future. You will grow into and out of it much faster than you think.

Novell NetWare
<http://www.novell.com/netware5/index.html>

Network Operating System (NOS): The Network Operating System is the software which runs on the server. Novell NetWare and Microsoft Windows NT are the dominant Network Operating Systems on the market. Either can be a **good** solution. Some schools and districts have implemented **Unix** for either a server operating system, or **as** the **basis** for a Web and/or E-mail server.

For the purposes of network management, it is preferable to pick one solution and stick with it network wide. The NOS typically provides file and print services, access control, and various other capabilities which support the users of the network.

Uninterruptible Power Supply (UPS):

Each server should be protected from power outages by connecting it to a UPS. This will provide power in the event of a loss of power from the electric utility company. Most network operating systems will sense the loss of commercial power and will shut down the server if it is not restored in a timely manner. This shutdown will prevent the loss or corruption of data. A UPS should also be used with critical workstations which might lose data if power is lost. They might also be needed for key network components such as routers, hubs, and other electrically powered devices.

Backup system: Each server should have a tape backup system which provides for regular (daily) backups of the software and the data on the server. Regular rotation of backup media should be used, and off-site storage practices should also be followed.

Cabling: Wiring necessary to support communications within the building is a long-term investment. If properly installed, it will support the needs of the school for a long time. Cabling should be based on a structured cabling plan which will support not only data needs but also voice and video in the future. All network components and design factors should conform to technical standards established by appropriate standards bodies where applicable.

Very specific standards, such as the EIA/TIA 568A standards, are available to describe cabling and installation. These standards not only support the communications requirements but also take into consideration other things such as building code and fire protection requirements.

Unshielded twisted pair (UTP) will meet most needs for cabling to workstations and other devices. Category 5 (Cat 5) describes the current preferred minimum cabling installation. Fiber optic cable may be required for connections which exceed the limits of UTP. These standards should be

**Terms, Equipment,
Descriptions, and
Examples for 10BaseT
(twisted pair) Networks.**
[http://web66.umn.edu/
Construction/Default.html](http://web66.umn.edu/Construction/Default.html)

**Resources and
Information about Local
Area Networks (LANs)
with an Emphasis on
Data-Communications
Technology**
[http://web.syr.edu/
~jmwobus/lans/](http://web.syr.edu/~jmwobus/lans/)

**Network Design Manual
with Continuing
Updates**
[http://techweb.cmp.com/
nc/netdesign/series.htm](http://techweb.cmp.com/nc/netdesign/series.htm)

**Technical Specifications
(EIA/TIA and others)**
[http://www.hubbell-
premise.com/](http://www.hubbell-premise.com/)

followed for both the selection of materials and their installation. Select your cable designer/installer carefully, and ensure that he complies with the standards. Also, review SDE facilities requirements, which will cover other aspects of installation, such as building codes and SDE regulations.

While most LANs have been installed using Ethernet 10base-T, which is a shared medium technology, the cabling system supports a migration path toward higher performance networking. For example, the Ethernet hub can be replaced with an Ethernet switch, and 10 megabit Ethernet can be upgraded to 100 megabit Ethernet. Each of these upgrades will improve performance at a relatively low cost. In the future, upgrades to ATM in the WAN as well as in some LANs will provide higher speed bandwidth and will support future applications, such as voice and video.

Documentation for Local Area Networks (LAN's)¹

In new installations and LAN upgrades, documentation is often an afterthought. It should not be. A network installation or upgrade requires several different kinds of documentation prepared and used at different stages of the installation and for ongoing operations. Five categories of documentation are described, each to be started and completed at different times throughout the installation cycle. Whether created and maintained internally by staff or externally by a vendor, documentation is key to the successful future of your Local Area Network.

System Operations and Configuration Manual

This manual should provide a complete description of the configuration of the system, including drawings of the physical and logical topology of the LAN. Additionally, it should outline all system administration and operations procedures which must be performed to administer, reconfigure, manage, and maintain effective network operations.

¹ Gartner Group/Datapro, "Documentation for Local Area Networks." June 13, 1997.

A complete inventory of all components of the system should be maintained with date purchased, serial numbers, and warranty information, as well as other items pertinent to the customer's specific operation.

User's Manual

The user's manual should provide a quick reference guide to basic LAN user operations. It should provide a system overview, introduce network features and capabilities, and provide procedures for basic LAN operations such as logging on or off the network, changing a user password, accessing network applications, and accessing shared file and print services.

Configuration Management Plan

This plan should outline the procedures to be used to request, evaluate, approve, and implement changes to the system design, system documentation, and the installed system.

Quality Assurance and Test Plan

The quality assurance and test plan should describe the overall approach for quality assurance activities. It should identify test and quality assurance objectives; describe the types of testing to be performed (e.g., burn-in testing, subsystem testing, integration testing, and final acceptance testing); provide a schedule for test activities; and describe test reporting requirements.

Training Plan

The training plan should outline all training objectives and the plan for satisfying those objectives. It should describe all courses incorporated in the training program, including training for the system administration personnel as well as help desk support staff and system users.

Troubleshooting Plan

This section should provide a framework for performing troubleshooting procedures for commonly encountered network and site-specific problems. It should identify common symptoms and provide suggested procedures for diagnosing and correcting associated problems. In addition, it should include procedures and associated forms (e.g., repair logs, trouble ticket tracking) for reporting and tracking problems as they are identified and resolved. Historical data should be maintained and scrutinized to identify patterns involving recurring problems.

Maintenance Plan

The maintenance section should discuss the overall maintenance plan and procedures. Appropriate preventive and corrective maintenance procedures should be outlined, and the recommended schedules and type/skill levels of the personnel performing the specified maintenance tasks should be provided. Recommended equipment spare parts levels should be identified.

Report Generation/Performance Monitoring

This section should discuss performance monitoring strategies and procedures. It should discuss data collection and analysis, operation of the networking management software, and generation of management reports. Auditing and performance monitoring of network traffic and services (disk, printer, and server utilization; terminal servers; etc.) should be defined. The section should also define what reports shall be generated and how frequently, as well as describe how these reports should be used to support ongoing planning and engineering as well as troubleshooting.

Points of Contact

This section should document key points of contact, both internally and externally. Internally, the organization and network administrative personnel responsible for each major component of the system should be listed with telephone

numbers for office, pager/beeper, voice mail, and home if policy dictates. Vendors and suppliers should be listed with sales contacts, support resources, and repair procedures.

References

The reference section should include a list of all documentation provided with the system's components, including hardware, software, installation, maintenance, user, and system administration/operations manuals furnished with the system components.

District Wide Area Network

To connect schools within a district together, each district should install a District Wide Area Network (WAN). This connectivity will support communications within school districts and access to statewide resources as well as access to the Internet. Because each school district has unique needs, a WAN for each district must be designed to meet the needs of that district. The District WAN will support sharing of information within the district by allowing access to servers at the various schools and at the district office. It also provides remote support for users, server maintenance, software downloads, and other support related functions.

Circuits to Connect Schools

Schools should work with the South Carolina Budget & Control Board's Office of Information Resources (OIR) to request circuits for each school and district office. OIR will work with the school to provide the appropriate type and speed circuit to connect to the District WAN. OIR reviews the district's requirements and orders the circuit for the school. Depending on various factors and the available technology, OIR may install various types of circuits. These include Frame Relay, Switched Multi-megabit Data Service (SMDS), point to point, and other appropriate types.

**Networking Vendors from
State Term Contracts:**

3Com [http://
192.156.136.22/erc/
index.html](http://192.156.136.22/erc/index.html)

Bay Networks

[http://
www.baynetworks.com/](http://www.baynetworks.com/)

Cisco Systems

<http://www.cisco.com>

**The Cisco Educational
Archives (CEARCH)**

<http://www.cearch.org/>

Each district should have a central site (typically the District Office) which serves as the control point for its WAN. Each district WAN should have one or more high speed circuits which connect it to the state's backbone network (SCINET).

After installation, OIR will, at the request of the district, evaluate performance on any circuit to determine its utilization. If it is determined that there is congestion on the specified circuit, OIR will upgrade the capacity to a level sufficient to ensure satisfactory performance. In some cases, the district may need to make changes to associated hardware and/or software to implement the upgraded capabilities.

Routers

A router can be used to link LANs together locally or remotely as part of a WAN. A network built using routers is often termed an internetwork. Routers operate at OSI Network Layer (Level Three) and can support particular Network Layer protocols, such as TCP/IP, DecNet and IPX. Most network routers support multiple protocols as necessary to support the devices attached to the LAN. They also support various protocols such as Frame Relay, SMDS, and PPP for WAN connections.

CSU/DSUs

DSU (Data Service Unit) - Data transmission equipment used to interface to a digital telephone circuit to equipment at a user site, typically to a router. It converts the user's datastream to the appropriate signal for transmission over the WAN. A Channel Service Unit (CSU) is often contained functionally within the DSU device. DSUs can convert data to or from a port on a router to a data circuit, such as a 64KBPS or a 1.544 MBPS (T-1) circuit. DSUs must be matched with the line speed of the circuit to which they will be connected.

LAN/WAN Protocols

Data being transmitted from device to device is formatted using specific formats which provide for transmission efficiency. All data transmitted to and from the Internet use a

suite of protocols referred to as **TCP/IP**. **IP** addresses are assigned to the schools and districts by OIR. Novell NetWare servers generally use **IPX** as a communications protocol. **IPX** is reasonably inefficient and is not transmitted through the **SCINET** backbone network. Schools are encouraged to migrate from **IPX** to **IP** for all communications. Other protocols such as AppleTalk may be used by some schools on their **LANs** but should not be routed to the **WAN**.

Web Servers

**A Guide for K-12 Schools
Wishing to Get on the
Internet**
[http://
198.114.144.101/K12TECH/](http://198.114.144.101/K12TECH/)

While searching the World Wide Web is a way for students to obtain resources from around the world, schools should also use the web as a way to post their own information. Web server technology is relatively easy to implement and should be used by both the school and district staffs as well as by students and teachers. The web server should serve as a location for school/district information which is made available to the community as well as the world.

Many schools and districts are creating web pages to communicate with parents, students, and others in the community. School activities, calendars, meeting notices, and other schedules are just examples of information being delivered. Many teachers are working with students to post information and projects they have developed, often on joint projects with students from other schools around the world. District offices should also be developing intranet technology to distribute information within the district and to support administrative applications.

Web Cookbook
[http://web66.umn.edu/Cook-
book/Default.html](http://web66.umn.edu/Cookbook/Default.html)

A web cookbook gives the recipes for setting up an Internet server in a school, or even in a classroom, with links in each recipe so that you can download every ingredient you need.

E-mail Servers

Schools and districts should implement electronic mail (e-mail) as a primary means of communication. At a minimum, e-mail accounts should be provided to administrators, teachers, and staff. To the extent practical, e-mail should also be **provided** to students.

E-mail interchange with the world should be based on Simple Mail Transfer Protocol (SMTP) with appropriate extensions for transfer of graphics, documents, and other embedded objects. E-mail software can frequently be installed on servers used for other purposes, such as file servers or web servers. Software can be obtained free or at relatively low costs. Some districts may choose to implement groupware applications which include functionality such as calendar coordination and document management in addition to e-mail.

Security:

Acceptable Use Policies

<http://chico.rice.edu/armadillo/Rice/Resources/acceptable.html>

Site Security Handbook

<http://ds.internic.net/fyi/fyi8.html>

Links to Security Related Sites

<http://www.ncsa.com/hotlinks/content.htm>

It is the responsibility of each school and district, as well as each user, to ensure the security of all systems and data. This includes the physical security, as discussed in the Physical Design section of this document, and system security. Generally, the greatest threat to system security comes from within the organization. Security begins with a comprehensive security policy. It should focus on system administration as well as user education. Network operating systems provide a substantial amount of security, but it must be properly implemented. School administration must support the policy, and users should be aware of their responsibilities as well as the consequences of violation of the policy.

Consideration should also be given to protection from outside, typically from hackers on the Internet. Protection from the outside can be provided by firewalls, which work in a variety of ways to allow only certain users and data to move into and out of the protected network.

Securing workstations can be a major issue. Users may change the settings of their workstations which can lead to major problems for network administrators. Many products are available on the market which permit full or partial locking of system features. Some of these programs allow multiple logins (different screens and access rights for teachers than for students, for example).

Video Technologies

Media Retrieval Systems: Media retrieval allows for centralization of all audiovisual equipment. Teachers can access and play materials using a remote or a touch tone telephone.

ETV Sites

<http://www.scetv.org/AboutETV/insitfs.html>

<http://www.scetv.org/nts/>

<http://www.scetv.org/nts/documents/delcs.html>

ETV/ITV: Tape and delay centers for short distance learning were begun in South Carolina twenty-five years ago and are now located throughout the state. Today these centers, now referred to as DELC centers, are much more than just facilities that broadcast prerecorded tapes. These centers have become actual live, interactive video production facilities and short distance learning studios.

In addition to classroom instruction, distance learning can provide staff development programs, short courses on test preparation skills and study habit skills, GED training and testing, adult education classes, health education updates, and more. Distance learning interactive courses are being offered more frequently each year. South Carolina is already performing this task on a national level through the Satellite Education Resources Consortium (SERC). This initiative uses satellite technology to bring live, interactive courses in math, science, and foreign language to under-served schools in 23 states. SERC delivers critical subjects and **advanced** courses to schools that, due to size and budget constraints, could not otherwise offer them. This **technology** is also available on a local level.

Electronic Video Conferencing

(two-way video and audio)

<http://www.coe.missouri.edu/~cjw/video/index.htm>

<http://www.coe.missouri.edu/~cjw/video/links.htm>

School districts are already seeing the advantages of local live productions. They enjoy the autonomy of assessing and addressing their specific needs. Time and money can be saved by using these facilities for faculty development programs and school support personnel training.

A next step in providing South Carolina's students with equitable access to learning opportunities is to provide two-way video courses, along with professional development and technical assistance for all schools.

III. Physical Design

Computers, projection devices, and networks are essential technology resources for students and teachers. However, the usefulness of these resources and users' satisfaction with them will be directly influenced by the physical environment in which they are placed. Examination must be made of the school as a whole as well as for the individual classroom, computer lab, and technology center.

Building-Wide Issues

Electricity

Is there sufficient power? Calculate the amount of electricity (in amps) that will be used by all of the computer-related equipment to be placed in a room. Work with your physical facilities department to make sure that the electrical circuits serving the room will support this load.

Are there enough electrical outlets and are they located where you need them? Provide the physical facilities department a room diagram that shows where you want to locate computers, printers, scanners, and projectors. A six-plug power strip will support three computers and their monitors. But you do need to make sure that all electrical cords are routed so people won't trip over them.

All computer equipment should be protected from electrical surges. Surge suppression can be built into the electrical circuits that serve a room, or you can use power strips that include surge suppression. Data lines that connect computers to the local area network also need adequate surge suppression.

HVAC

Is there sufficient cooling? Compared with other rooms in schools, computer labs need extra cooling, as computer equipment generates heat. Is the humidity level controlled? If the room's air conditioning is not adequate, large fans and dehumidifiers can help.

Security

What measures need to be taken to assure security of equipment?

Physical Arrangement of Classrooms

Since technology changes the dynamics of instructional delivery, should the room be rearranged? Are there physical structures such as pull down maps or other items that must be worked around or accounted for that need special attention? Students need flat, clear work space around computers. Allow plenty of space around network printers for people and for storing paper, ink, and toner supplies.

Lighting

Is there enough/too much light? Do everything you can to reduce the glare on monitor and projection screens. Wide slat, dark colored Venetian blinds can help control sunlight coming through windows. The glare produced by fluorescent lights can be significantly reduced by adding filtering lenses. Glare can also be reduced by painting walls with a matte rather than a glossy paint.

Can window light be sufficiently blocked? In rooms where projectors are used to display computer images, presenters should be able to reduce the level of ambient light around the projection screen.

Wallboards

Dust generated, especially by chalk, can be very harmful to systems. Have chalkboards been replaced with whiteboards? In rooms where computers are used, chalkboards should be replaced with white marker boards if feasible. Rooms in which computer equipment is located should be vacuumed more frequently than other rooms. Computers have cooling fans that draw in room air and deposit dust on their electrical components. As this dust builds up, the components overheat, which can cause damage.

Furniture

What furniture will need to be added or removed? Compared with carrels, open desks and tables provide more work space and make it easier for teachers and students to communicate and collaborate. Keyboard height and monitor height are important for students' comfort and health. The most common problem is placing keyboards and monitors too high. Avoid this problem by purchasing furniture that fits the students who will be using it. You can also purchase adjustable-height tables and slide-out keyboard trays. Then consider, how can projection best be handled for the room configuration?

Chairs also affect students' comfort, health, and learning. If at all possible, buy chairs that have five wheels (less likely to tip over), good lower back support, and lever or button-controlled height adjustment. Also, to reduce long-term maintenance costs, buy high quality chairs.

IV. Technical Support and Systems Maintenance

Nothing will create a greater level of frustration than to provide hardware and software that is not operational due to inadequate technical support. There are two aspects to maintaining operational systems: human resources and support tools.

Human Resources

Investment in responsive, reliable technical support is critical to successful use of technology in the classroom. If teachers cannot be assured that help is available to keep the system operational and to answer usage questions, they will not use the system. It is vital that individuals are available that are very good at problem solving and interpersonal communications.

Technical Support staff

Technical support staff will be necessary to provide configuration and fix-it services.

In-house vs. Outsourcing/Privatizing (all or parts)

Typically the effectiveness of out-sourced services are measured in terms of average response/closure rate. Advantages to outsourcing can be: ready access to a broader base of expertise (especially in rural areas where hiring local expertise can be a problem), greater flexibility in scaling of services to meet periods of high and low demand, and ability to provide services without additional district/school staffing. Disadvantages can be: loss of control over the individuals doing the service and additional expense. Industry standards typically call for one technician per 200 computers. In education, the ratio is more frequently one technician per 500 computers or more.

Help Desk

Many support problems are related to usage questions for software and systems. A cost effective means of resolving many of these problems is to provide a local or toll-free phone number for a Help Desk staffed by individuals with skills to effectively interpret usage problems and communicate the steps to resolve those problems.

On-site Support Staff

While technically specific assistance might be best delivered from a district level, many technical assistance and usage concerns can best be handled by adequate and appropriate local school staffing. Ideally, each school should have at least one 1.0 FTE dedicated systems support person. This should be an individual that can diagnose and resolve most technical issues and in a non-threatening way provide one-on-one help. The best means to ensure technology will become an integral part of classroom delivery is to supplement staff development efforts with continuing on-site service. This individual should be a part of, or tightly integrated with, the school media/information literacy program.

Support Tools

In order to be effective, technical and on-site school support staff must have appropriate tools in order to be able to do their job. These tools can also have the added benefit of increasing the ability of the end-user to be self-sufficient in the operation of the systems.

Training

Technology changes at an ever increasing rate. In order to adequately provide much needed assistance, regular training must be available to learn new and updated technologies.

Hardware/Software

Every support person will need at least a basic toolkit with a variety of screwdrivers, needlenose pliers, cable line testers, crimpers, anti-static wipes, canned air, disk cleaning tools, spare printer cables, monitor cables, and power cords. It would also be very helpful to provide each technical support person a laptop with a portable CD-ROM drive and tape backup drive. They will also need bootable disks, utility disks, copies of a variety of operating systems (DOS, Win 3.1, Win95, etc.), diagnostics and anti-virus software, and workstation security software.

Reference Material

To be able to effectively research and resolve problems, every support person will need reference manuals. Most valuable is direct access to the Internet where up-to-date data are available and files and other resources are available for downloading. A listing of sites, contacts, and resources would be helpful. Also valuable would be print publications. Many quality technology oriented magazines are available free of charge. Finally, reference manuals and guides appropriate to the hardware, software, and operating systems being used can help speed troubleshooting.

On-going Systems Maintenance

Technology, by nature, is dynamic. Upgrades to hardware, software, and networks will occur at a constant and predictable rate in a well-managed environment. Innovations in the content available for students and teachers, as well as the delivery tools for that content, will continue to evolve. The on-going support and maintenance for a school's system is, therefore, a critical component in the successful deployment of information technology in the classroom.

One of the best references for on-going system support is the manufacturer. All provide written documentation at the time of purchase (either on paper, floppy disc, or CD) and most now maintain Internet sites. These will be key resources for the successful management of your technology environment.

Maintenance

All new system components (e.g. PC's, printers, etc.) should be purchased with strong consideration given to the initial guarantee/warranty period as well as extended plans for support and maintenance. In many cases, a multi-year maintenance contract can be included as a required component of the initial purchase.

Manufacturers have clearly stated recommendations for cleaning, which should be strictly followed. Recommendations for the successful replacement of expendable parts (e.g. print cartridges) should also be noted. All recommendations for proper power supplies and surge and lightening protection should be adhered to, particularly in climates where severe thunderstorms prevail in the summer months. Expensive computer based technology should never be powered by a non-grounded AC source.

Maintenance can be accomplished via three basic methods: an employee can assume responsibility for these functions, a vendor can provide services on an out-sourcing basis, or combination of the above. In any case, good planning will be required so that adequate financial resources can be budgeted on an annual basis.

Obsolescence

The computer technology environment has one of the highest obsolescence rates when compared to other classroom instructional tools like chalkboards and desks. The rapidly evolving ratio of price versus performance in the computer chip alone has seen the industry PC standard move from the 386 to the Pentium processor in just a few years. Many industry experts state that the average life of a PC is now 3-5 years, if the processor can be upgraded along the way. Keyboards, on the other hand, will last longer in a well protected environment and shorter in a high usage environment. Monitors can be adversely affected by sunlight, which will shorten their usable lifespan. In general, the useful life of computer technology has a great deal to do with proper attention to the manufacturer's recommendations and the rapidly evolving nature of the industry.

Upgrades/Refreshes

A well-planned information technology environment will consider and budget for the replacement of a certain percentage of equipment on a yearly basis. If a resource like a PC is given a five year usable life, then financial provisions need to be made for replacing 20% of the PC inventory each year. Creative ways to extend the life of computers should be employed by schools. For instance, allowing students to participate and assist with the upgrade process could be a valuable educational enhancement for the classroom or Computer Club.

Management of software licenses is a critical component of a well planned environment. The proper registration of the user sometimes qualifies for free upgrades in the future, but only if proper licensed ownership can be documented. Be cautious of software upgrades that do not allow for a smooth and seamless transition from one version to another, and check for compatibility between your old files and the new software version before eliminating the older software application. You may want to keep both running for a period of time if there is a compatibility problem and if you have valuable materials stored in an older software version. Illegal use of software is not condoned under any circumstances. A policy should be in place to address school personnel and students loading new applications onto school PCs due to licensing issues as well as hardware capability considerations.

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